PATENT SPECIFICATION

886,487

Inventor: CLAUDE GIDDEY

Date of filing Complete Specification: March 13, 1958

Application Date: March 14, 1957. *No.* 8517/57

Complete Specification Published: January 10, 1962

Index at Acceptance:—Classes 49, B1(B:H:J:L:N:S:V); 2(3), H(1:2); and 5(2), J2, J3(F1:F2:G4:G6:G7:G10), J5.

International Classification:—A23l. C07g. A23k.

COMPLETE SPECIFICATION

NO DRAWINGS

Improvements in and relating to Edible Protein Compositions

We, F.P. RESEARCH LIMITED, a Company incorporated in accordance with British Law, of Wyvern Mill, Melton Mowbray, Leicestershire, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with edible protein compositions and their production, and has for one of its objects to provide an improved protein composition for use as foodstuffs for animals or human beings, for example as synthetic meat or meat-like food.

According to the present invention there is provided a protein composition comprising edible artificial fibres consisting wholly or predominantly protein and a binder which comprises a complex of a binder protein with at least one polysaccharide having side groups which can react with the binder protein, said fibres being bonded together by said binder.

The side groups of the polysaccharide may be acidic, but since the reactivity to proteins of polysaccharides with acidic side groups increases with increase in the acidic character of these side groups, such side groups should be relatively strongly acid. Polysaccharides having sulphate side groups, of which carrageenin is a commercially available example, are suitable for carrying the invention into effect, but other reactive polysaccharides may be used.

Further according to the present invention there is provided a process for producing a protein composition comprising the steps of preparing a binder liquor by adding to an aqueous dispersion of a binder protein a polysaccharide having side groups which react with the binder protein, incorporating therewith edible artificial fibres consisting wholly or predominantly of protein, removing, after reaction between the binder protein and the polysaccharide has occurred, the liquid portion of said binder liquor while the fibres are incorporated therewith and forming a compact mass comprising the fibres and the solid portions of the binder liquor.

The fibres may be incorporated with the binder liquor by immersing the fibres therein, in which case the aqueous dispersion of protein preferably contains from 30 to 300 g. protein per litre, but 80 to 150 g. per litre is particularly suitable. Moreover, the ratio of fibre to binder in the resulting protein composition preferably lies between 3:1 and 3:20 based on the dry weight, about 1:1 being the optimum ratio. This corresponds to the dry weight of fibres used to the total dry weight of binder protein and polysaccharide contained in the volume of liquor in which the fibres are immersed. It is also preferable for the protein to be finely dispersed, and this is conveniently achieved by precipitating the protein from aqueous solution by adjusting the pH value of the solution to approximately that of the isoelectric point of the protein, usually from pH 4.5 to 5.5.

On the dispersed particles of protein is formed, by reaction with the polysaccharide, a protein-polysaccharide complex which can, when fibres are immersed in the binder liquor and after the removal of the liquid phase of the liquor, serve as a binder to bond the fibres into a compact mass.

Carrageenin to be used as the polysaccharide should be added to the aqueous dispersion at concentrations of from 1 to 50 g. per litre in the case of a refined, highly reactive carrageenin preferably about 10 g. per litre,

to give a ratio by weight of binder protein to polysaccharide of from 10:3 to 100:1, and preferably from 10:1 to 20:1.

The binder liquor, which is a dispersion or slurry, may be used at any temperature from 20 to 100°C, an increase in temperature increasing the extent of the reaction between the protein and the polysaccharide and hence the binding properties of the complex. It is preferable to heat the aqueous dispersion gradually to about 80°, for example over a period of 20 minutes.

The fibres may be immersed in the liquor after the addition of the polysaccharide, and need not be dry before immersion. The liquor may be heated before the introduction of the fibres, and the fibres then immersed in the hot liquor, but it is preferable to immerse the fibres in the liquor before heating, and then to heat the liquor in the presence of the fibres.

When the reaction between protein and polysaccharide in the binder liquor has occurred, and the fibres are thoroughly soaked—these operations may be effected successively or simultaneously—the liquid phase of the slurry comprising the binder liquor is separated from the fibres and the solid part of the binder liquor, and the fibres and the said solid part are compressed together to form a compact mass which solidifies on cooling. The separation and the compression are conveniently carried out in one operation by centrifuging the binder liquor with the fibres immersed therein, for example in a tube or unperforated basket centrifuge.

When the mass has cooled, the fibres are bonded together by the binder to form a protein composition which may be cut into pieces as required.

The structure of the protein composition may be modified by subsequent heating in an aqueous medium, with or without salts, and in this way products of different hardness may be produced. The product may be sterilised, for example at temperatures above 100°C., and this operation may also serve to modify the texture of the material, for example by affecting chewiness in the case of a synthetic meat.

Flavouring and colouring matters may be incorporated in the protein composition, for example by adding them to the binder liquor before the elimination of the liquid phase. They may also be injected into the finished meat-like food.

Fibres suitable for use in the invention must be edible per se and should consist wholly or predominantly of protein, and the type of fibre may be chosen to give a desired analysis or texture to the resulting protein composition. Suitable proteinaceous fibres may be obtained in conventional manner, or as described in our co-pending Patent Application No. 8516/57 (Serial No. 886486), according to which fibres are produced from protein solutions containing a polysaccharide having strongly acidic side groups which can react with the protein, such as carrageenin, with the optional addition of alginates. Since it is possible to produce such fibres with high moisture contents and since the binder characteristic of the present invention can also be produced with a high moisture content, the present invention permits the production of a composition of high overall moisture content and consequent tenderness in the mouth.

Proteins suitable for use as binder proteins for the purposes of the present invention may be of animal or vegetable origin, and are preferably readily soluble, usually under weakly alkaline aqueous conditions, and readily precipitated, for example by adjusting the pH value of the solution to a value approximately equal to the isoelectric point of the protein. Examples of such proteins are blood serum proteins, including albumin and fibrin, gelatine, casein, zein, soya protein, ground-nut protein, edestin and cotton-seed protein.

The following are examples of ways in which the invention may be carried into effect.

Example 1.

One kilogram defatted ground-nut meal (containing about 50% protein) is stirred for 1½ hours at room temperature in 10 litres water, adjusted to pH 8.5 with sodium hydroxide. The solid matter is then removed by centrifuging at 500 g in a basket centrifuge with a nylon cloth. Ten parts of the clear extract so obtained are used to extract in a similar way one part of fresh defatted ground-nut meal, and after the second centrifuging a clear extract is obtained which contains 100 g. protein per litre together with other soluble substances. The pH value of the extract is then adjusted by means of hydrochloric or lactic acid to the isoelectric point of the protein (which is pH 4.7 for ground-nut protein), the protein being precipitated and a slurry obtained containing 100 g. protein per litre. 10 g. per litre powdered refined carrageenin (Gelcarine MR 80 obtainable from Algin Corporation of America), is then dispersed in the slurry. Edible proteinaceous fibres of high moisture content prepared according to Application No. 8516/57 (Serial No. 886486) are then immersed in and soaked in this binder liquor, 100 g. wet fibre (moisture content about 70%) being added to 500 g. liquor, and the mixture of slurry and fibres is heated gradually in a water-bath or steam-jacket over a period of 20 minutes to a temperature of 80°C. The hot mixture is then centrifuged at 100 *g* in a non-perforated basket centrifuge until the solid and liquid

phases are separated. The solid phase is cooled, and is then removed, the product being a meat-like food of high moisture content and consequent tenderness, which can thereafter be cut into small pieces. It may be sterilised by heating at 100-120°C. for 20 minutes, the texture and chewiness being improved at the same time.

Example 2.

A clear extract containing 50 g. groundnut protein per litre is prepared by extracting one part of defatted ground-nut meal with 10 parts of water at pH 8.5 and centrifuging as described in Example 1. The pH value of this extract is then adjusted to pH 4.7 with hydrochloric acid, and the precipitated protein separated as a 200 g. per litre slurry and washed in a yeast separator. The washed slurry was diluted to 100 g. per litre protein content, and 10 g. Gelcarine MR 80 per litre stirred in. To this binder liquor are added edible proteinacous fibres as in Example 1, and the mixture is heated, centrifuged and cooled as described in Example 1. The resulting product is a meat-like food of similar properties to that obtained by Example 1.

Example 3.

A washed slurry containing 200 g. groundnut protein per litre is prepared as described in Example 2. 10 g. Gelcarine MR 80 per litre is stirred into the slurry, edible protein fibres are added, and the mixture is heated, centrifuged and cooled as described in Example 1.

Example 4.

A washed slurry containing 200 g. groundnut protein per litre is prepared as described in Example 2. The slurry is diluted until it contains 30 g. protein per litre, and 10 g. Gelcarine MR 80 per litre is stirred in. To this binder liquor are added edible proteinaceous fibres, and the mixture is heated, centrifuged and cooled as described in Example 1.

Example 5.

100 g. isoelectric casein (produced by precipitation at the isoelectric point) is dispersed in one litre of water, and the pH value adjusted to 8.5 by means of sodium hydroxide. When the protein has dissolved, the pH value is adjusted to 4.6 by means of hydrochloric acid, and to the slurry of precipitated protein so produced is added 10 g. Gelcarine MR80 per litre. Edible proteinaceous fibres are immersed in this binder liquor and the process is continued as described in Example 1.

Example 6.

100 g. isolated soya protein (substantially freed from soluble impurities) is used in place of 100 g. casein in the process described in Example 5.

Example 7.

100 g. of a commercial mixture of blood serum proteins (containing fibrin, albumin and globulin) per litre is used in place of casein in the process described in Example 5, the pH of the solution of protein being adjusted to 5.0 to precipitate the protein.

WHAT WE CLAIM IS:

1. An edible protein composition comprising edible artificial fibres consisting wholly or predominantly of protein and a binder which comprises a complex of a binder protein with at least one polysaccharide having side groups which can react with the binder protein, said fibres being bonded together by said binder.

2. A protein composition according to claim 1, wherein the polysaccharide is a polysaccharide having sulphate side groups such as carrageenin.

3. A protein composition according to any one of the preceding claims, wherein the ratio of the dry weight of fibre to the total dry weight of binder protein and polysaccharide is from 3:1 to 3:20.

4. A protein composition according to any one of claims 1 to 3, wherein the binder protein comprises ground-nut protein.

5. A protein composition according to any one of claims 1 to 3, wherein the binder protein comprises soya protein.

6. A protein composition according to any one of claims 1 to 3, wherein the binder protein comprises casein.

7. A protein composition according to any one of claims 1 to 3, wherein the binder protein comprises a protein derived from blood serum.

8. A process for producing an edible protein composition comprising the steps of preparing a binder liquor by adding to an aqueous dispersion of a binder protein a polysaccharide having side groups which react with the binder protein, incorporating therewith edible artificial fibres consisting wholly or predominantly of protein, removing after reaction between the binder protein and the polysaccharide has occurred the liquid portion of said binder liquor while the fibres are incorporated therewith, and forming a compact mass comprising the fibres and the solid portions of binder liquor.

9. A process according to claim 8 wherein the artificial fibres are incorporated with the binder liquor by immersing the fibres therein, and the liquid portion is removed by centrifuging.

10. A process according to claim 8 or 9, wherein the ratio of the dry weight of fibres to the total dry weight of protein and polysaccharide contained in the volume of binder liquor with which the fibres are incorporated is from 3:1 to 3:20.

11. A process according to any one of claims 8 to 10, wherein said aqueous dispersion of a binder protein contains from 30 to 300 g. protein per litre.

12. A process according to claim 11, wherein the aqueous dispersion of a binder protein contains from 80 to 150 g. protein per litre.

13. A process according to any one of claims 8 to 12, wherein said aqueous dispersion of binder protein is formed by precipitation of the protein from an aqueous solution of the protein by adjusting the pH value of the solution to a value approximately equal to the isoelectric point of the protein.

14. A process according to any one of claims 8 to 13, wherein the polysaccharide comprises carrageenin, and the concentration of polysaccharide in said binder liquor is from 1 to 50 g. per litre, the ratio by weight of binder protein to polysaccharide being from 10:3 to 100:1.

15. A process according to claim 14, wherein the concentration of polysaccharide in said liquor is 10 g. per litre.

16. A process according to claim 14 or 15, wherein the ratio by weight of binder protein to polysaccharide is from 10:1 to 20:1.

17. A process according to claim 14, wherein said binder liquor attains a temperature of approximately 80°C while the fibres are immersed therein.

18. A process for producing a protein composition substantially as hereinbefore described with reference to any one of the examples.

REDDIE & GROSE,

Agents for the Applicants,

6, Bream's Buildings,

London, E.C.4.

PROVISIONAL SPECIFICATION

Improvements in and relating to Protein Compositions

We, F.P. RESEARCH LIMITED, a British Company, of Wyvern Mill, Melton Mowbray, Leicestershire, England, do hereby declare this invention to be described in the following statement:—

This invention is concerned with improvements in and relating to protein compositions, such, for example, as synthetic meat.

It is an object of the invention to provide an improved process for the production of compact masses of protein fibres.

In the production of compact masses of protein fibres in accordance with the invention the protein fibres are bound together with a protein-polysaccharide complex formed by heating protein with a sulphated polysaccharide.

The invention also consists in compact masses comprising protein fibres bound together with a protein-polysaccharide complex.

The binder, i.e. the protein-polysaccharide complex, used in the compact masses of the invention, may be obtained in accordance with the invention by precipitating protein from a protein solution to form a slurry, dissolving a sulphated polysaccharide in the slurry and heating. In producing the compact masses of protein fibres, the fibres may be added to the protein slurry containing the sulphated polysaccharide in solution prior to the heating step. Then after heating to form the complex with the precipitated protein, the mass is compacted and the liquid separated, e.g. by centrifuging. After cooling, a compact mass of protein fibres is obtained. Cooling may precede the compacting or compression of the mass.

The ratio by weight of binder to fibre used in forming the compact masses in accordance with the invention is from 1:4 to 1:15 and is preferably in the region of 1:8.

The sulphated polysaccharide used may be carrageenin or a carrageenin modified as to its cation content (Na, Ca, K, etc.) e.g. Gelcarine MR.

The production of compact masses of protein fibres in accordance with the invention is described, by way of example, in greater detail below.

An aqueous protein extract containing from 5 to 20%, and preferably 14%, by weight of protein and of a pH of from 7 to 9 is obtained in known manner. Hydrochloric acid or other acid is added to the extract to reduce the pH value to 4.7, i.e. the iso-electric point of the protein. This results in the precipitation of the protein to form a slurry. From 0.1 to 1% by weight of a carrageenin, e.g. Gelcarine MR, is added to the slurry and dissolved in the liquid part of the slurry.

Protein fibres, obtained in conventional manner or as described in our co-pending Patent Application No. 8516/57 (Serial No. 886486), entitled "Protein Fibres" and filed on the 14th day of March, 1957, are then immersed in the slurry and this is followed by heating to a temperature from 20 to 100°C, and preferably to about 80°C. This results in the formation of a solid protein-carrageenin complex on the precipitated protein. The liquid part of the slurry is separated and the residue compressed and cooled to form a compact mass. The separation of the liquid and the compression may be carried out simultaneously by centrifuging.

The structure of the compact mass obtained may be modified by heating in

aqueous medium with or without hardening salts. When the mass is intended for use as synthetic meat, this after-treatment may be carried out during sterilization.

REDDIE & GROSE,
Agents for the Applicants,
6, Bream's Buildings,
London, E.C.4.

Berwick-upon-Tweed: Printed for Her Majesty's Stationery Office, by The Tweeddale Press Ltd.—1961
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.